Integrated Water Quality and Aquatic Communities Protocol – Lakes and Ponds

Standard Operating Procedure (SOP) #3: Site Selection and GRTS

Draft Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

The SOP explains the procedure that is undertaken to populate the list of sites that the field crews are to sample for a particular field season. Rationale for choosing these methods are detailed in the protocol narrative and the reader is referred to the relevant section for more details.

Site Selection for CRLA Ponds and Lakes

Crater Lake National Park (CRLA) presents an unusual challenge for selecting perennial habitats. Although there are 37 lakes/ponds identified using USGS topographic and GIS shapefiles, many of these are not perennial. Preliminary site visits during the pilot project indicated that of 23 habitats observed, all but four of these are dry by the end of the water year (31 October 2008). Based on this ratio, we only expect a maximum of seven perennial habitats in CRLA. See the narrative for more discussion on this topic.

Hence, the site selection for CRLA is to sample *all* perennial, lentic habitats. Using the data from the pilot project, the first year of implementation will only visit the sites identified as having water at the end of the water year. As future visits determine water presence/absence, the sampling list will be adjusted accordingly (if repeat visits show a habitat to be perennial).

Site Selection for Lassen Volcanic National Park Ponds and Lakes

The procedure for developing a site list will only be necessary once, at the beginning of the project.

1. Available GIS shapefiles from the National Wetland Inventory project are obtained from their web site (http://wetlandsfws.er.usgs.gov/) or obtained from the park GIS Specialist.
2. A list of suitable perennial ponds and lakes is created based on the following criteria:

   a. The water body is <1000 m from an established trail or road.
   b. The water body is <25 m deep.
   c. The slope of the surrounding terrain is <30%.
3. The judgment site is removed from the available list (Lake Helen).
4. The remaining list is then used in GRTS (Generalized Random Tessellation Stratified) software, a plug-in for the statistical program "R," (below text and Figure 1). This application compiles a list of 18 random samples of water bodies in a spatial stratified structure.
5. These 18 sites are considered the "index" sites for repeat monitoring (15 to be sampled, four extra in case any are unsuitable for sampling). After the first 15 are determined to be suitable for sampling, the "index" sites are fixed for the life of the project.
6. The procedure is repeated using GRTS on the remaining water bodies, again selecting random but spatially stratified lakes to be "survey" lakes. This list will then be used in order (to maintain the spatial balance) to determine the survey lakes for the next 10 sampling periods (30 years).
7. After 30 years of implementation, the survey site panels will be repeated. For example, the 15 survey lakes sampled in year 1 will be resampled in year 30, survey lakes sampled in year 3 will be resampled in year 33, etc.

Running GRTS in "R" requires knowledge of the program and programming that is beyond the scope of this protocol. However, background information and how to information is included here: http://www.epa.gov/nheerl/arm/designing/design_intro.htm

The code used in "R," once the library spsurvey is added, should look like this:

```
## Choosing Lakes: GRTS Example
path←"\\Water_Quality_Monitoring\\Pilot_Study\\Lakes_GIS\\GRTS\\working\\"
library(spsurvey)

design  <- list(None=list(panel=c(Index=18, Time1=18, Time2=18, Time3=18,
Time4=18,Time5=18, Time6=18, Time7=18, Time8=18, Time9=18,
Time10=18),seltype="Equal",over=100))

grts(design, DesignID="Site", SiteBegin=1, type.frame="area",
  src.frame="shapefile", in.shape=paste(path,"lakes_select",sep=""),
sp.object=NULL, att.frame=NULL,
  id=NULL, xcoord=NULL, ycoord=NULL, stratum=NULL, mdcaty=NULL,
startlev=NULL,
  maxlev=11, maxtry=1000, shift.grid=TRUE, do.sample=TRUE,shapefile=TRUE,
  prjfilename=NULL, out.shape=paste(path,"LAVO_WQ_Sites",sep=""))
```

Specific purposes of the programming are detailed in Figure 1.

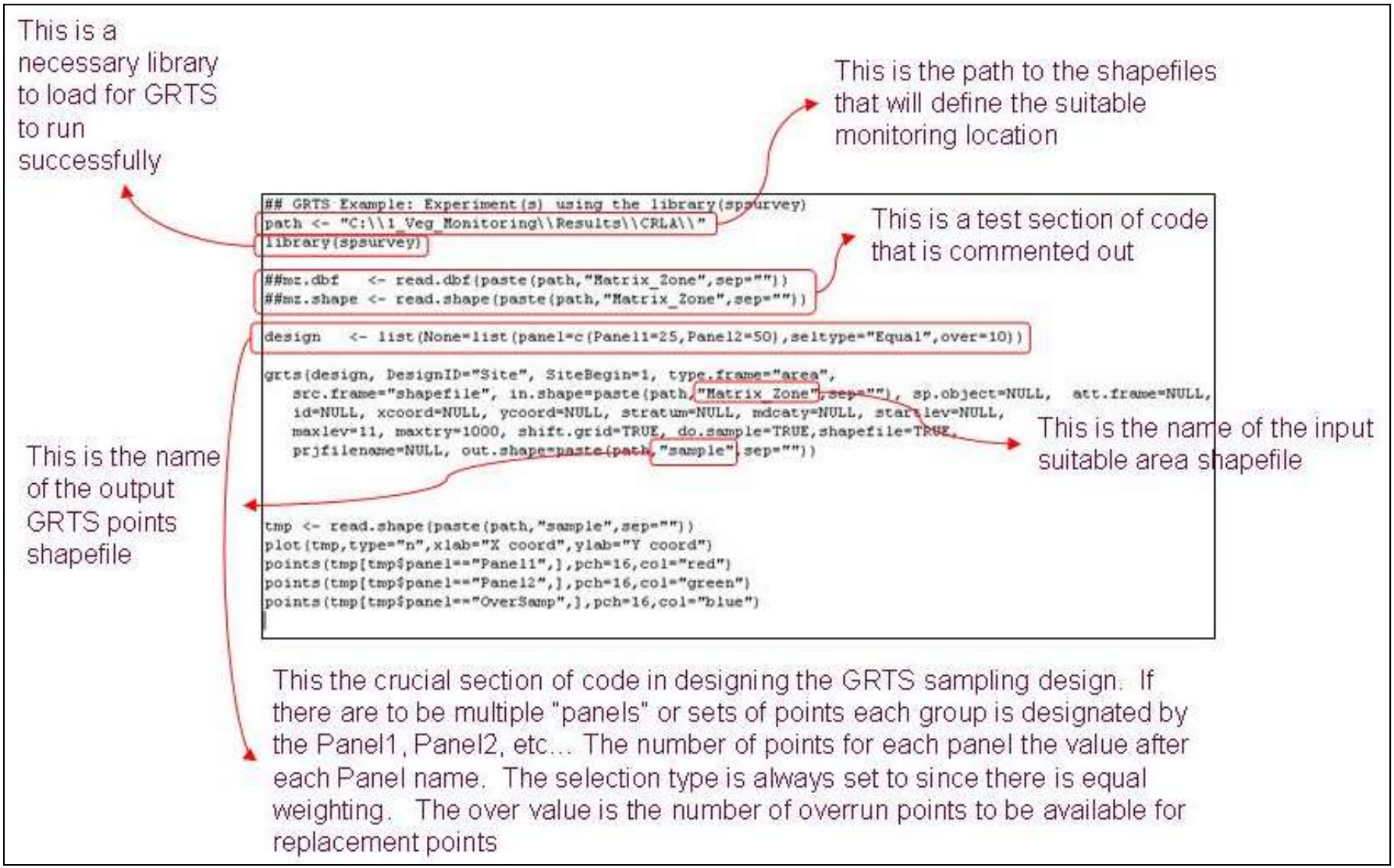

Figure 1. Layout of GRTS code to be run in the Software "R."